Synthesis of biodiesel, its characterization and performance evaluation as an alternative to conventional fuels.

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DOCTOR OF PHILOSOPHY

In

Environmental Science

By

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Under the guidance of

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DECLARATION

The research work embodied in this synopsis entitle **"Synthesis of biodiesel,characterization and performance evaluation as an alternative to conventional fuel"** will be carried out in the laboratory of School of Basic sciences & Technology, IIMT University, Meerut. The work is original and has not been submitted in part or full for any degree or diploma of this or any other University.

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Introduction:

To meet the energy demands of rising populations and excessive dependence is on fossil fuels. There is a need to look for an alternative fuel that is eco-friendly, renewable, biodegradable, non-toxic with better fuel properties like less particulate matter, higher cetane number and less pollutant (Mahila et.al.,2020). One of the best alternatives is biodiesel but the challenges to present biodiesel as a substitute against fossil fuel involves cost effectiveness and eco-friendly nature (M.Munir et.al.,2021)

Previously, biodiesel was made from edible sources like corn oil , soybean oil], sunflower oil, and palm oil, which posed a challenge with food security as it caused competition in the food supply, As a result, the switch from edible to non-edible or used cooking oil (UCO) or low cost feed stocks containing high free fatty acids (FFA) has excellent chances to produce biodiesel that is cost- effective, better quality similar to that of the current biodiesel(Neha Rawat et.al.,2024) Utilizing used culinary oil prevents it from being carelessly dumped into waterways, causing water contamination and complicates the cleaning process. UCO may betransformed into a vast variety of useful products, like biodiesel, detergent, polyurethane,lubricant, biohydrogen, and energy. The most common method of extracting value fromUCO is turning it to biofuel.

The main obstacles while utilizing these resources into low-cost biodiesel is the creation of supply chain for feed stock for constant production (Daminghuang et.al.,2012).

The synthesized biodiesel will also be used for the industrial process like bio lubricants and biobased surfactants. Biodiesel's growing importance as a fossil fuel substitute and bioenergy's environmental and endless supply are also helpful. Valorization of this synthesized biodiesel into cost-effective and eco-friendly industrial products will be a significant move toward sustainable green energy use and may lower crude oil imports by 5-10% (Neha Rawat et al.,2024)

GHG emission are being reduced using biodiesel in diesel engines, and more can be achieved through the projected increase in biodiesel production and its combustion as fuel (OyetolaOgunkunle et.al.,2019)

Literature Gap:

Research gaps in biofuel production in the production of biofuels is the high reliance on food crops, which has an influence on land use and water resources. Additionally, the focus of the research is on economic efficiency rather than comprehensive environmental studies. In scientific study, there is a lack of complete coverage, particularly with regard to themes such as commerce, biodiversity, and human health. This is especially true in the Southern Hemisphere, which is a region where potential socio-economic gains and environmental losses overlap. In addition, there are gaps in our

understanding of the indirect impacts of biofuels, the evolution of production methods for long-term aims, and the necessity of research that crosses disciplines in order to address concerns of sustainability on a global scale .

DamingHuang (2012) Biodiesel as one promisingalternative to fossils fuel for diesel engines and it can be produced by in Soybean and methanol via transesterification in presence of acid catalyst but there are some issues for e.g. Land area and high cost of biodiesel if these issues resolved properly, it would be reasonable to believe that in the near future biodiesel will be widely applied in automobile industry

Sang HyuckPark (2019) Synthesis of biofuel from waste cooking oil, thereby removing transportation costs from the university. Analysis using FT-IR, GC-MS, and NMR confirms that the biodiesel is a combination of five FAMEs. Our diesel generator exhaust gas examination shows that the biodiesel burns almost completely to CO2 and H2O with no hydrocarbons, and thermodynamic and viscosity investigations confirm that the fuel is suitable.

Erdiwansyah et.al (2019) Addition of alcohol/biodiesel to diesel engines can result in more varied performance. Alcohol based fuel have a high latent heat of vaporization and oxygen content which provides anti-knock qualities and better combustion efficiency and increase % of alcohol fuel CO, HC emission increase and NOx emission decrease.

Table 1: The table depicts the recent work in the field of Biofuels:

S. No	Study	Finding	Source
1	Biobased surfactant using chlorosulfonic acid.	RSM	Rawat et.al 2024
2	Biodiesel synthesis from microalgae	Reduce GHGs	Gaurav et.al 2024
3	Biodiesel synthesis from WCO via electrolyte	Enhance yield of 90%	Darwin et.al 2023
4	Biodiesel synthesis using lipase enzyme as catalyst	Technology yield maximum	Fatima et.al 2022
5	Biodiesel production using montmorillonite catalyst	use green catalyst, yield 83%	Munir et.al 2021
6	Biodiesel synthesis using resin acid catalyst	Increase production with help of amberlyst 120	Yolanda et.al 2021
7	Biodiesel synthesis using biocatalyst	Cetane value are higher & Good Fuel	Abolanle et.al 2020
8	Biodiesel adoption in vehicle diesel	Technology design to make future energy investment	Oyetola et.al 2019
9	Biodiesel production using CaO nano catalyst	Yield 96% from WCO	Tadesse et.al 2019
10	Biodiesel production by one step pretreatment Using NaoH	Reducing saponification Increase yield%	Xiao et.al 2018

Objective of the Work:

The major objective of the project is to synthesize biodiesel, its characterization and performance evaluation as an alternative to conventional fuels. The scope of the study comprises the following steps:

1.Identification of the natural resources for e.g. waste cooking oil, mustard oil, castor oil.

2.Synthesis of biodiesel by the process of transesterification by using natural resources.

3. Characterization of synthesized biodiesel.

4. Analysis of physicochemical properties of synthesized WCO.

5. Performance evaluation as an alternative's fuels.

6. Data compilation, comparison and paper writing.

Synthesis Scheme

Scheme 1: Synthesis of Biodiesel

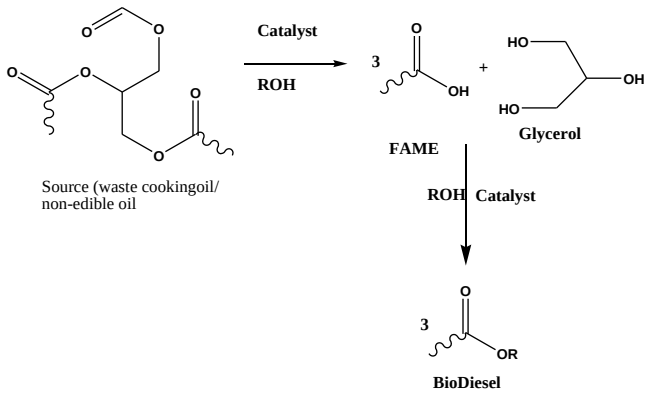


Fig 1: Synthesis of biofuel from identified source.

Justification of the Topic proposed

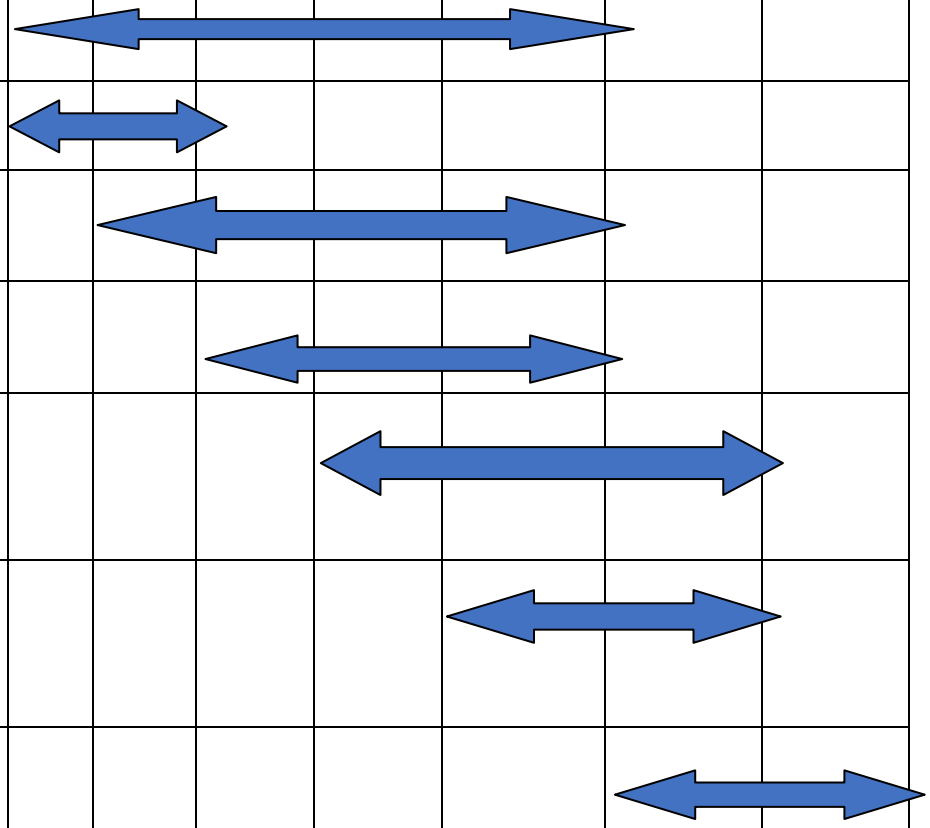
Prior to this point, synthesizing biodiesel from edible oil has received some criticism as it creates shortage of food leading to increase in its cost. In the present study authors have made an attempt to utilize the used cooking oil for the synthesis of biodiesel utilizing a nano-catalyst. This catalytic conversion promotes an ecofriendly and economically feasible process. The final products, biodiesel and in the process may be utilized in future as an alternate to traditional energy sources which may be regarded as the **"Future Fuel".**

Plan of Work:

The month wise plan of work is shown in the Time-Table given below.

Time-table or milestones

Activities	**Duration in months**						
	0-3	3-6	7-12	13-18	19-24	25-30	31-36
Literature review							
Identificationof source.							
Synthesisof the biodiesel							
Characterization of the synthesized biodiesel							
Analysis of Physicochemical properties of biodiesel							
Performance evaluation as an alternative's fuels.							
Data compilation, comparison and paper writing							



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